

CLAIMS

1. A method for determining endpoint of a plasma etching operation of a surface on a wafer, the surface of the wafer having features being etched, comprising:
applying collimated light onto the surface of the wafer;
detecting reflected light from the surface of the wafer, the reflected light being detected by discrete detection regions, each detection region being configured to portray a unique signal across a frequency band;
identifying one of the detection regions to correlate with a model optical signal; and
executing endpoint of the plasma etching operation based on feedback from the identified one of the detected regions, the execution of endpoint being performed during the etching of the features on the surface.
2. The method of claim 1, wherein the collimated light is received from a source through a light source fiber optic bundle to a fiber optic aperture of a lens, the lens collimating and directing the collimated light to the surface of the wafer.
3. The method of claim 2, wherein the fiber optic aperture includes light detector fibers, the light detector fibers being interleaved with light source fibers from the light source fiber optic bundle at the fiber optic aperture.
4. The method of claim 3, wherein the discrete detection regions are defined by the light detector fibers, the discrete detection regions corresponding to an area on the surface of the wafer from which reflected light is detected by the light detector fibers.

5. The method of claim 1, further comprising:
transmitting the detected reflected light from the surface of the wafer to an imaging spectrometer;
analyzing the detected reflected light by the imaging spectrometer;
matching an optical signal from the analyzed detected reflected light to a model optical signal; and
selecting the matched optical signal to determine endpoint of the plasma etching operation.

6. The method of claim 5, wherein the imaging spectrometer includes a two dimensional charge coupled device (2D-CCD) array for analyzing the detected reflected light.

7. The method of claim 5, wherein the 2D-CCD array is configured to display the unique signal across a frequency band for each detection region.

8. A system for etching a wafer, the system capable of determining endpoint of a plasma etching operation of a surface on a wafer, the surface of the wafer having features being etched, comprising:

a detector for detecting reflected light from the surface of the wafer, the reflected light being detected by discrete detection regions, each detection region being configured to generate a specific optical signal across a frequency band, one of the detection regions being configured to correlate with a model optical signal,

whereby endpoint of the plasma etching operation is based on feedback from an identified one of the detected regions.

9. The system of claim 8, wherein when the one of the detection regions being configured to correlate with a model optical signal is determined, the specific optical signal of the one of the detection regions is from the identified one of the detection regions and is used to determine endpoint of the plasma etching operation.

10. A method for determining endpoint of plasma processing of a semiconductor wafer, comprising:

providing a light source;

providing a lens system to collimate and align light from the light source to an active surface of the semiconductor wafer;

interleaving a plurality of light detector fibers among light source fibers, the light source fibers transmitting light from the light source to the lens system and terminating in a fiber optic aperture at the lens system, the light detector fibers being interleaved among the light source fibers at the fiber optic aperture;

transmitting light through the lens system at the active surface of the semiconductor wafer;

receiving reflected light from the active surface of the semiconductor wafer at the plurality of light detector fibers;

providing an imaging spectrometer;

transmitting the received reflected light at the plurality of light detector fibers to the imaging spectrometer;

analyzing the received reflected light by the imaging spectrometer;

matching an optical signal from the analyzed received reflected light to a model optical signal; and

selecting the matched optical signal to determine endpoint of the plasma processing.

11. The method of claim 10, wherein the imaging spectrometer includes a 2-D CCD detector array.

12. The method of claim 11, wherein the 2-D CCD detector array provides a plot of at least one optical signal from the plurality of light detector fibers, the plot providing a visual representation of the at least one optical signal that can be matched to a model endpoint optical signal.

13. The method of claim 10, wherein the plasma processing of the semiconductor wafer is plasma etch processing.

14. The method of claim 10, wherein the plasma processing of the semiconductor wafer is plasma deposition processing.

15. The method of claim 10, wherein the matching of an optical signal from the analyzed received reflected light to a model optical signal is accomplished by matching an optical signal from each of the plurality of light detector fibers in parallel with the model analyzed signal and identifying a greatest signal contrast.

16. The method of claim 15, further comprising selecting the identified greatest signal contrast and monitoring the selected signal for a match to an endpoint signature.

17. The method of claim 10, wherein the matching of each of an optical signal from the analyzed received reflected light to a model optical signal is accomplished by matching an optical signal from each of the plurality of light detector fibers in parallel with the model analyzed signal and arbitrating the optical signal from each of the plurality of light detector fibers to identify a maximum acceptable error level.

18. The method of claim 17, further comprising selecting one of the optical signals from each of the plurality of light detector fibers to determine endpoint of a plasma process having a lowest error level below the maximum acceptable error level.

19. A plasma processing system for use in semiconductor manufacturing, comprising:

a plasma processing chamber having an interior region, an exterior, and a viewport providing visual access to the interior region from the exterior;

a light source configured to provide a broad beam light for directing through the viewport onto an active surface of a semiconductor wafer positioned within the interior region of the plasma processing chamber;

a plurality of detector optical fibers, each of the plurality of detector optical fibers having a detection end and an analysis end, each detection end being positioned in a fiber optic aperture of the lens system;

an imaging spectrometer, the imaging spectrometer receiving the analysis end of each of the plurality of detector optical fibers; and

a 2-D CCD detector array to analyze a received optical signal from each of the plurality of detector optical fibers,

wherein an endpoint of plasma processing is determined based on an analysis of the received optical signal from each of the plurality of detector optical fibers.

20. The plasma processing system of claim 19, wherein the analysis of the received optical signal from each of the plurality of detector optical fibers includes matching the received optical signal from each of the plurality of detector optical fibers to a model optical signal for a desired endpoint to plasma processing.

21. The plasma processing system of claim 19, wherein the CCD detector array provides a plot of at least one analyzed received optical signal.

22. The plasma processing system of claim 19, wherein the plasma processing chamber is a plasma etch chamber.

23 The plasma processing system of claim 19, wherein the plasma processing chamber is a plasma deposition chamber.